

REMARKS/ARGUMENTS

1. Amendments to the Claims

As the scope of claim 1 is narrower than intended, the applicant has amended claim 1
5 accordingly. Claim 2 has been amended to correct typographical errors. Claim 3 has been
cancelled without prejudice or disclaimer.

As the scope of claim 4 is narrower than intended, the applicant has amended claim 4
accordingly. Additionally, claim 4 has been amended to include limitations recited in claim 1.
Claim 5 has been amended to correct typographical errors. Claim 6 has been cancelled
10 without prejudice or disclaimer.

As the scope of claim 7 is narrower than intended, the applicant has amended claim 7
accordingly. The subject matter of claim 7 and dependent claims thereof have been amended
to read "RF receiver". Claim 10 has been amended in response to the amendments made to
claim 7. Claim 8 has been cancelled without prejudice or disclaimer.

15 Claim 14 is newly entered to include limitations fully supported by Fig. 2, Fig. 13, and
related description in the specification.

Claim 15 is newly entered to include some limitations recited in claim 7 and a complex
filter, which are fully supported by Fig. 2, Fig. 13, and related description in the specification.

As no new matter is introduced, consideration of above-identified claim amendments is
20 respectfully requested.

2. Claim Objections

Claim 11 is objected to because of the following informalities: In claim 11 line 2 the
limitation "comprise" should be rewritten as "comprises".

25 **Response:**

Claim 11 has been cancelled.

3. Claim Rejections – 35 USC 102

Claims 1-3, 7-10, and 13 are rejected under 35 U.S.C. 102(b) as being anticipated by Wynn (US Patent 6,009,317).

Response:

5 Claim 1

Examiner states that the claimed step of modifying the second signal by a portion of the first signal is anticipated by elements 74 and 76 shown in Wynn Fig. 3 and specification col. 6, lines 55-60 of Wynn's disclosure. However, the applicant disagrees. The rationale is given as
10 below.

In col. 6, lines 55-60, Wynn teaches using a phase splitter to output a quadrature carrier signal according to an in-phase carrier signal provided to the in-phase mixer. Therefore, as one can see, the prior art phase splitter is unable to adjust the output of the quadrature mixer directly. Changing the phase of the quadrature carrier signal will change the actual phase of
15 the quadrature signal generated from the quadrature mixer; however, Wynn fails to teach or suggest, implicitly or explicitly, adjusting the quadrature signal by a portion of the in-phase signal to reduce the phase mismatch. In other words, in col. 8, lines 12-15, Wynn merely teaches using a quadrature phase angle control signal to control the tunable filter, and there is no description stating that the quadrature phase angle control signal applied to the tunable
20 filter is able to make the output of the quadrature mixer modified by an adjustment determined by a portion of the output of the in-phase mixer. As the adjustment made to the quadrature signal is not controlled by a portion of the in-phase signal according to Wynn's disclosure, the applicant asserts that the phase mismatch calibration taught by Wynn is unable to anticipate the claimed phase mismatch calibration. That is, the claimed limitations of
25 determining a portion of the first signal and modifying the second signal by the portion of the first signal are neither taught nor suggested by Wynn. Therefore, claim 1 has overcome the rejections under 35 U.S.C. 102(b).

Additionally, in Jeong Fig. 2, a detailed circuit architecture of the cited gain and phase

correction circuit illustrates that the output quadrature signal Q_{out} includes a signal component given by a product of the input in-phase signal I_{in} and a multiplication factor. The applicant however asserts that Jeong's teaching still fails to teach or suggest the claimed feature "modifying the second signal by the portion of the first signal so that a phase difference
5 between the modified second signal and the first signal becomes substantially close to 90 degrees". Referring to Jeong's teachings, the modified second signal (e.g., Q_{out}) and the first signal (e.g., I_{in}) are sure to have a phase difference not equal to 90 degrees. Therefore, the combined teachings of Wynn and Jeong fail to teach or suggest the claimed limitations in claim 1.

10 In conclusion, Wynn's architecture compensates the I/Q imbalance by adjusting the LO phases, which leads to more complicated realization procedure because the quadrature LO mechanism is realized by QVCO or frequency divider. The adjustment using this architecture faces the difficulty to put another phase adjusting mechanism, such as phase
15 phase interpolators, between the QVCO and the mixer. And the power consumption of these phase interpolators is usually very high, which appears not practical in the design for wireless portable applications.

In Jeong's architecture, the adjustment is performed in the digital domain. However, the hardware cost raises exponentially with respect to the phase error, the signal bandwidth, and the IF frequency. The digital circuits, especially the analog-to-digital
20 converter (ADC), need to accommodate the extra bits for further adjustment using digital multiplication on the down-converted signals.

In comparison the invention adjusting the I/Q imbalance is achieved, as described in claim 1, by modifying the second signal by a portion of the first signal. The architecture keeps the front-end circuits be easily realized with small power consumption and lower
25 cost.

In light of above statements, the applicant believes claim 1 has been placed in condition for allowance. Consideration of claim 1 is respectfully requested.

Claim 2

Claim 2 is dependent upon claim 1, and should be allowed if claim 1 is found allowable.

5 Claim 3

Claim 3 has been cancelled.

Claim 7

10 In light of above statements under Claim 1, the applicant believes that the claimed feature “combining a portion of the first signal with the second signal to make the phase difference of the first signal and the second signal substantially equal to 90 degrees” is not anticipated by Wynn, and claim 7 has overcome the rejections under 102(b) accordingly. Additionally, the claimed limitations are neither taught nor suggested by the combined teachings of Wynn and Jeong. The applicant therefore believes that claim 7 has been placed
15 in condition for allowance. Consideration of claim 7 is respectfully requested.

Claim 8

Claim 8 has been cancelled.

20 Claims 9, 10, and 13

Claims 9, 10, and 13 are dependent upon claim 7, and should be allowed if claim 7 is found allowable.

25 **4. Claim Rejections – 35 USC 103**

Claims 4-6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wynn (US Patent 6,009,317) in view of Jeong (US publication 2003/0095589 A1).

Response:

Claim 4

In light of above statements under Claim 1, the applicant asserts that the claimed step of utilizing the programmable phase calibration device to reduce the phase mismatch in the pair of quadrature signals through modifying the second signal by a portion of the first signal is not anticipated by Wynn. As shown in Jeong Fig. 2, a detailed circuit architecture of the cited gain and phase correction circuit illustrates that the output quadrature signal Q_{out} includes a signal component given by a product of the input in-phase signal I_{in} and a multiplication factor, the applicant asserts that Jeong's teaching still fails to teach or suggest the above-mentioned claimed step in claim 4. Firstly, in claim 4 of application' invention, the first signal and the second signal are claimed to be outputs of the first mixer and the second mixer respectively. Therefore, when the input in-phase signal I_{in} and the input quadrature signal Q_{in} taught by Jeong are interpreted as the claimed first signal and second signal respectively, Jeong's disclosure only teaches adding a portion of the first signal (i.e., a product of the input in-phase signal and a multiplication factor) to a portion of the second signal (i.e., a product of the input quadrature signal and another multiplication factor) according to the circuitry shown in Fig. 2. In other words, Jeong doesn't teach or suggest modifying the second signal by a portion of the first signal, where the first signal and the second signal are outputs of the first mixer and the second mixer respectively.

The applicant therefore asserts that the claimed step of utilizing the programmable phase calibration device to reduce the phase mismatch in the pair of quadrature signals through modifying the second signal by a portion of the first signal is neither taught nor suggested by combined teachings of Wynn and Jeong, and claim 4 has overcome the rejections under 35 U.S.C. 103(a).

Claim 5

Claim 5 is dependent upon claim 4, and should be allowed if claim 4 is found allowable.

Claim 6

Claim 6 has been cancelled.

Claims 11 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wynn (US Patent 6,009,317) and Jeong (US publication 2003/0095589 A1), and further in view of Underwood et al. (US Patent 4,937,535).

5 **Response:**

Claim 11

Claim 11 has been cancelled.

Claim 12

10 Claim 12 is dependent upon claim 7, and should be allowed if claim 7 is found allowable.

5. Patentability of New Claims 14 and 15

Claim 14

15 Newly added claim 14 claims a complex filter having input ports electrically connected to the phase calibration module. The applicant asserts that this feature is not taught or suggested by the cited references and any reasonable combinations. The rationale is given as below.

20 Regarding Wynn's teachings, Wynn teaches using a phase splitter connected to the quadrature mixer for adjusting the phase of the quadrature carrier signal. The phase splitter has no connecting node coupled to either of the in-phase signal transmitting path and the quadrature signal transmitting path. If Wynn's phase splitter is combined with the prior art receiver shown in Fig. 1 of applicant's disclosure, the combined teachings still fails to teach the claimed RF receiver architecture requiring a complex filter having input ports electrically connected to the phase calibration module because the phase splitter has to be connected to
25 the quadrature mixer.

Regarding Jeong's teachings, Jeong discloses a gain and phase correction circuit in a **digital** baseband section for processing baseband signals outputted from the preceding direct conversion receiver (Fig. 1). As Jeong's art gain and phase correction circuit is a digital

baseband processing circuit instead of an analog IF processing circuit, if it is combined with the prior art receiver shown in Fig. 1 of applicant's disclosure, the combined teachings still fails to teach the claimed RF receiver architecture requiring a complex filter having input ports electrically connected to the phase calibration module because the gain and phase
5 correction circuit (i.e., a digital baseband processing circuit) is not allowed to be connected to input ports of the analog complex filter.

Regarding Underwood's teachings, Underwood's invention is directed to calibrating signal measurement channels of a measurement or analysis system, which is different from the technical field of wireless communication. In addition, Underwood's invention is not
10 pertinent to calibrating phase mismatch between orthogonal signals. Furthermore, as stated in col. 3, lines 57-66, Underwood discloses using the phase calibration to make phase shifts among all channels to be zero, which is different from the desired objective of generating orthogonal signals having phase difference substantially equal to 90 degrees.

In light of above statements, the claimed features are not anticipated by each of the cited
15 reference, and are neither taught nor suggested by combined teachings of cited references. Additionally, newly added claim 14 is dependent upon claim 7, and should be allowed if claim 7 is found allowable.

Claim 15

20 Newly added claim 15 claims a complex filter having input ports electrically connected to the amplitude calibration module. The applicant asserts that this feature is not taught or suggested by the cited references and any reasonable combinations. The rationale is given as below.

Regarding Wynn's teachings, Wynn teaches using multipliers in a **digital** signal
25 processor to achieve amplitude balance (col. 7, lines 27-34). If Wynn's digital multipliers is combined with the prior art receiver shown in Fig. 1 of applicant's disclosure, the combined teachings still fails to teach the claimed RF receiver architecture requiring a complex filter having input ports electrically connected to the amplitude calibration module because the

prior art complex filter is an analog IF processing circuit and Wynn's multipliers (i.e., digital baseband processing circuits) are not allowed to be coupled to input ports of the analog complex filter.

Regarding Jeong's teachings, Jeong discloses a gain and phase correction circuit in a
5 **digital** baseband section for processing baseband signals outputted from the direct conversion receiver (Fig. 1). Similarly, if Jeong's digital gain and phase correction circuit is combined with the prior art receiver shown in Fig. 1 of applicant's disclosure, the combined teachings still fails to teach the claimed RF receiver architecture requiring a complex filter having input ports electrically connected to the amplitude calibration module because the prior art complex
10 filter is an analog IF processing circuit and Jeong's gain and phase correction circuit (i.e., a digital baseband processing circuits) is not allowed to be coupled to input ports of the analog complex filter.

Regarding Underwood's teachings, Underwood's invention is directed to calibrating signal measurement channels of a measurement or analysis system, which is different from
15 the technical field of wireless communication. In addition, Underwood's invention is not pertinent to calibrating gain mismatch between orthogonal signals. Moreover, as stated in col. 3, lines 23-39, Underwood merely discloses applying the gain calibration to make an output of a channel equal to an input of the same channel. In col. 10, lines 26-29, Underwood further discloses calibrating the channels one by one (steps 120 and 122 shown in Fig. 7). In other
20 words, the prior art gain calibrations applied to all of the existing channels are independent of each other. However, newly added claim 15 claims that the amplitude calibration module is for adjusting at least one mixer output and is further connected to input ports of the complex filter. Therefore, newly added claim 15 claims that the amplitude calibration module is disposed between the mixers and the complex filter to reduce the magnitude mismatch.
25 Suppose Underwood's programmable phase-gain amplifier is combined with the prior art receiver shown in Fig. 1 of applicant's disclosure to anticipate the claimed RF receiver architecture. The prior art programmable phase-gain amplifier is unable to reduce the magnitude mismatch between in-phase and quadrature mixer outputs due to independent

channel calibration. That is, the prior art programmable phase-gain amplifier makes an input of the complex filter and an output of the in-phase mixer have the same magnitude, and makes another input of the complex filter and an output of the quadrature mixer have the same magnitude; however, the prior art programmable phase-gain amplifier is unable to
5 reduce the magnitude difference between the in-phase and quadrature mixer outputs when inserted between the mixers and the complex filter.

In light of above statements, the claimed features are not anticipated by each of the cited reference, and are neither taught nor suggested by combined teachings of cited references. The applicant therefore believes that claim 15 has been placed in condition for allowance.
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Applicant respectfully requests that a timely Notice of Allowance be issued in this case.

Sincerely yours,
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Note: Please leave a message in my voice mail if you need to talk to me. (The time in D.C. is 12 hours behind the Taiwan time, i.e. 9 AM in D.C. = 9 PM in Taiwan.)